emissions violate even basic rules such as the Stefan–Boltzmann law, which states that the total energy radiated by a black body scales with its temperature by the fourth power. Recent work highlights other problems, such as that much of the optical light from quasars comes from regions that are much larger than disk models predict[8].

One revealing faux pas highlights the fact that some astronomers like to 'see what they believe'. In 1984, many in the field rejoiced when the first sensitive orbiting ultraviolet telescope obtained a temperature for one AGN that agreed with the prediction of the accretion disk model. Then, an amateur astronomer spotted a missing factor of ten in Newton's gravitational constant in the analysis. The model no longer fitted and the authors quickly issued a correction. Yet the erratum[9] is hardly cited, whereas the original paper has more than 100 citations.

The AGN field seemed to see a breakthrough in 1995, when orbiting X-ray telescopes became sensitive enough to detect high-energy iron emission lines that are broadened by rapid motions and gravity close to the black hole. Astronomers have again struggled to find a sensible theory. The prevailing scenario is that the lines are produced by a mysterious X-ray source that hovers above a disk of cold material. Although there have been preliminary claims of validation of this theory[10,11], in my view there is no good evidence yet that the iron line strengths follow variations in the X-ray continuum brightness closely and with little delay as one would expect.

The X-ray evidence for the disk reprocessing model is minuscule compared with more developed studies of optical line variability. Even stranger, bumps on the iron emission-line profiles persist for days, implying that the X-ray source somehow manages to float above the same spot even while the disk spins, which seems impossible. Adjustments to the theory, such as that the bending of light scrambles the responses of the lines to the continuum, only add more complexity. X-ray and ultraviolet AGN astronomers rarely talk to one another, even though both groups work on processes in the inner disk.

I see fewer and fewer serious theory papers on AGNs, but there is a burgeoning effort to find ever more quasars in surveys. It is as if, having given up on understanding AGNs, the community now focuses on the more modest goal of counting them. Sadly, the statistical analysis of astronomical surveys leads to further problems, such as claiming causal links in plots of dependent variables[12].

WHERE NEXT?

We have found thousands of quasars in the past 50 years, but we still don't have good physical models for how they radiate their prodigious energy. Without predictive theories we have nothing — our best hope for understanding quasars is that extraterrestrials might drop in and explain them to us.

Astronomers working on AGNs need to take a cold, hard look at their models and discard those that are unrealistic or have been falsified by observations. We need to use more sensitive X-ray telescopes to make detailed studies of the emission lines arising in the vicinity of the black hole. And we need advanced computational modelling of black holes, including magnetism, fluid dynamics, thermal balance and radiation. I hope to do my bit by elucidating the raw spectrum of radiation produced by the central engines of active galaxies, after removing distortions caused by surrounding gas and dust[13].

I urge my junior colleagues to spend 15 minutes a day thinking, palms down and eyes on the ceiling. That's just 3% of their time. As I saw recently on a Californian bumper sticker: "Don't just do something, sit there." ■

Robert Antonucci *is professor of astrophysics at the University of California, Santa Barbara, California 93106, USA.*
e-mail: skiantonucci0@gmail.com

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Scientists are snobs

It is a mistake to dismiss the people and projects coming out of lesser-known institutions, argues **Keith Weaver** — they have strengths too.

We all do it. Pressed for time at a meeting, you can only scan the presented abstracts and make snap judgements about what you are going to see. Ideally, these judgements would be based purely on what material is of most scientific interest to you. Instead, we often use other criteria, such as the name of the researchers presenting or their institution. I do it too, passing over abstracts that are more relevant to my work in favour of studies from star universities such as Stanford in California or Harvard in Massachusetts because I assume that these places produce the 'best' science.

As someone who is based at a less well-known institution, the University of South Dakota in Vermillion, I see other scientists doing the same to me and my students. In many cases, this is a loss: to my students and their projects, which could have benefited from the input, and to the investigators who might have missed information that could have been useful in their own work.

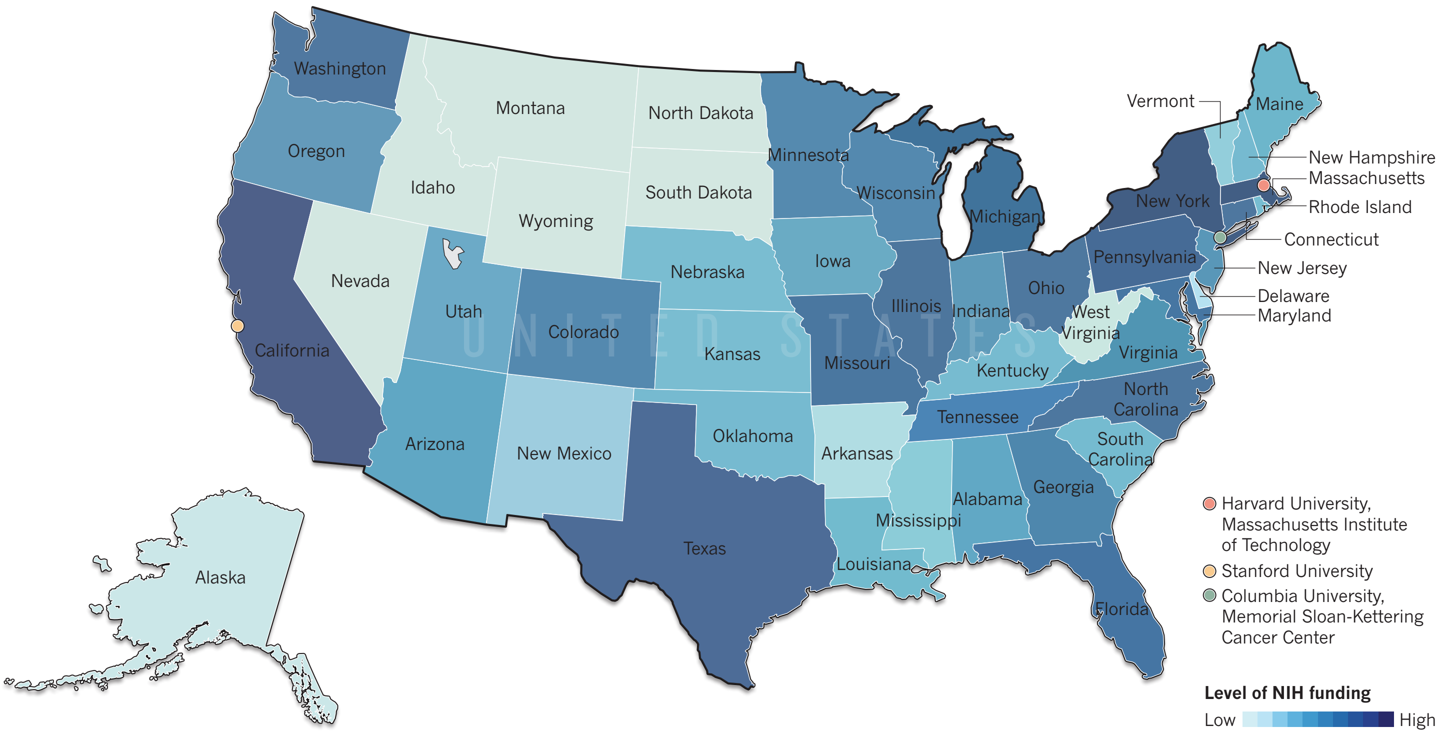
Of potentially greater impact is the effect this scientific snobbery has on citation practices. My laboratory was the first to describe a system in a Gram-positive bacterium that uses a small, non-coding RNA to block expression of a toxin in plasmid-containing cells, ensuring that only those cells survive (K. E. Weaver *RNA Biol.* **9,** 1498–1503; 2012). The system allows the persistence of plasmids that carry antibiotic-resistance genes, and points to a new mechanism for subverting that resistance. If we can find a way to interfere with the function of the regulatory RNA, we could conceivably induce the cells to commit suicide. Follow-up work by colleagues in larger labs has demonstrated that hundreds of related systems exist on plasmids, phage and chromosomes in numerous Gram-positive bacteria, including some important pathogens.

Although these colleagues were diligent in citing my original work, recent papers describing a system similar to my own in another bacterium cited only a more recent study from a large US National Institutes of Health laboratory. Losing this and other worthy citations could ultimately affect my ability to get promoted and attain grants. ▶

COMMENT

MIDDLING WORK

Academics based in states such as those that persistently receive less funding from the US National Institutes of Health (NIH) can be snubbed by other researchers, regardless of the quality of their science.



SOURCE: NIH

Such snobbery arises from a preconceived idea that many scientists have — that people end up at smaller institutions because their science has less impact or is of lower quality than that from larger places. But many scientists choose smaller institutions for quality-of-life reasons, as I did. I moved to the University of South Dakota in 1989 after starting a family. Having lived in several large cities during my training, I was attracted to the small-town atmosphere of Vermillion with its good schools and safe streets. The smaller size of the medical school class and the graduate programme also made for a more personal learning environment. Although I was expected to publish papers and obtain grants, it was clear that I would not have to receive multiple grants to pay most of my salary, get promotions and obtain a tenured post.

I am not blind to the disadvantages. It is more difficult for me to get graduate students and postdocs to join my lab, because of the belief that working at a bigger department is better for their career. And even if the size of the institute isn't an issue, many people prefer to live in a city rather than spend several years in a small town. As a result, my lab typically contains only a handful of people and so has to select research questions that are narrower in scope.

This focus brings advantages. With fewer people to supervise, when my collaborator wants a gel done, I do it myself. This keeps me grounded in the realities of experimental science, and means that my problem solving and interpretive skills stay sharp. It also provides a constant reminder of why I got into this job in the first place.

My students speak to me nearly every day, and do not have to rely on fleeting sightings of me on campus or in a monthly meeting, as is the case in many larger departments. I feel confident about the work that they are doing and the quality of their data, because I am involved every step of the way. So although the volume and scope of work I produce might be less than I could accomplish at a larger institution, I like to think that the quality is comparable. I believe that this makes the students' experience more enriching — the best and brightest students might not always apply to my lab, but those who do have more of a chance to improve their education.

"Many scientists choose smaller institutions for quality-of-life reasons."

A small place is also less bureaucratic. Several years ago, our medical school did away with the traditional department structure and formed a single Division of Basic Biomedical Sciences. This reorganization would have been much more difficult at a larger department with more faculty members. The greater interaction between disciplines has benefited academic staff and students alike. Group lab meetings include people working in other fields, such as anatomy or eukaryotic biology, and have led to interesting collaborations. I also feel that I have more of an impact on administrators than I would at a top-tier institution — I know the dean well, and can walk into his office and offer my opinion.

Unfortunately, these traditional academic values might not always pay off. As far back as 1965 — when biomedical research was a far less cutthroat business — one study showed that scientists gained more recognition from a name tag that mentioned a prestigious institution than from their own highly productive work (D. Crane *Am. Sociol. Rev.* **30,** 699–714; 1965). And a map of funding from the National Institutes of Health makes it clear that many states are persistently underfunded (see 'Middling work'). Whether that pale-blue gap in the middle of the country is the cause or the result of preconceptions about scientists from those regions is unclear. There are also fewer researchers in these empty spaces than in California or Massachusetts, but I am one of them.

At your next conference, try to stop at a poster that interests you from a smaller institution. I guarantee that the author will appreciate it. Talk to the scientists; visit their lab to see the quality of their science for yourself. Consider including more scientists from small places in your collaborations. We're all snobs sometimes, but awareness is the first step to changing behaviour. ■

Keith Weaver *is professor of microbiology at Sanford School of Medicine, University of South Dakota, Vermillion, South Dakota 57049, USA.*
e-mail: keith.weaver@usd.edu